Pacific Gas and Electric Company

Diablo Canyon Power Plant
P.O. Box 56
Avila Beach, CA 93424
805/545-6000

Robert P. Powers
Vice President–Diablo Canyon
Operations and Plant Manager

April 28, 1997

PG&E Letter DCL-97-069

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Docket No. 50-323, OL-DPR-82
Diablo Canyon Unit 2
Licensee Event Report 2-97-002-00
Reactor Trip on Low-Low Steam Generator Water Level Following the Failure of Main Feedwater Pump 2-1 Due to Mechanical Problems

Dear Commissioners and Staff:

Pursuant to 10 CFR 50.73 (a)(2)(iv), PG&E is submitting the enclosed licensee event report regarding an automatic reactor trip of Diablo Canyon Power Plant Unit 2 on low-low steam generator water level due to mechanical problems with Main Feedwater Pump 2-1.

This event did not adversely affect the health and safety of the public.

Sincerely,

Robert P. Powers

cc: Steven D. Bloom
Ellis W. Merschoff
Kenneth E. Perkins
Michael D. Tschiltz
Diablo Distribution
INPO

Enclosure

DPS/2246/N0002023

IE22

CATEGORY 1

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9705060078 DOC.DATE: 97/04/28 NOTARIZED: NO DOCKET #
FACIL:50-323 Diablo Canyon Nuclear Power Plant, Unit 2, Pacific Ga 05000323
AUTH.NAME AUTHOR AFFILIATION
BACKMAN,V.A. Pacific Gas & Electric Co.
POWERS,R.B. Pacific Gas & Electric Co.
RECIP.NAME RECIPIENT AFFILIATION

SUBJECT: LER 97-002-01:on 970329,reactor tripped on low level SG water level due to mechanical problems.Lube oil sys was flushed & filters & strainer were replaced.W/970428 ltr.

DISTRIBUTION CODE: IE22T COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 8
TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	PD4-2 PD	1	1	BLOOM,S	1	1
INTERNAL:	ACRS	1	1	AEOD/SPD/RAB	2	2
	AEOD/SPD/RRAB	1	1	FILE CENTER	1	1
	NRR/DE/ECGB	1	1	NRR/DE/EELB	1	1
	NRR/DE/EMEB	1	1	NRR/DRCH/HHFB	1	1
	NRR/DRCH/HICB	1	1	NRR/DRCH/HOLB	1	1
	NRR/DRCH/HQMB	1	1	NRR/DRPM/PECB	1	1
	NRR/DSSA/SPLB	1	1	NRR/DSSA/SRXB	1	1
	RES/DET/EIB	1	1	RGN4 FILE 01	1	1
EXTERNAL:	L ST LOBBY WARD	1	1	LITCO BRYCE,J H	1	1
	NOAC POORE,W.	1	1	NOAC QUEENER,DS	1	1
	NRC PDR	1	1	NUDOCS FULL TXT	1	1

C A T E G O R Y 1 D O C U M E N T

NOTE TO ALL "RIDS" RECIPIENTS:
PLEASE HELP US TO REDUCE WASTE. TO HAVE YOUR NAME OR ORGANIZATION REMOVED FROM DISTRIBUTION LISTS OR REDUCE THE NUMBER OF COPIES RECEIVED BY YOU OR YOUR ORGANIZATION, CONTACT THE DOCUMENT CONTROL DESK (DCD) ON EXTENSION 415-2083

FULL TEXT CONVERSION REQUIRED
TOTAL NUMBER OF COPIES REQUIRED: LTTR 25 ENCL 25

1084

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Diablo Canyon Unit 2	0 5 0 0 0 3 2 3	1 OF 7

TITLE (4)

Reactor Trip on Low-Low Steam Generator Water Level Following the Failure of Main Feedwater Pump 2-1 Due to Mechanical Problems

EVENT DATE (5)			LER NUMBER (6)			REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MON	DAY	YR	YR	SEQUENTIAL NUMBER	REVISION NUMBER	MON	DAY	YR	FACILITY NAME	DOCKET NUMBER
3	29	97	97	- 0 0 2 -	0 0	4	28	97		

OPERATING MODE (9)	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR (11)	
1	X	10 CFR 50.73(a)(2)(iv)
POWER LEVEL (10)		OTHER
1 0 0	(SPECIFY IN ABSTRACT BELOW AND IN TEXT, NRC FORM 366A)	

LICENSEE CONTACT FOR THIS LER (12)

	TELEPHONE NUMBER	
	AREA CODE	
Vickie A. Backman - Senior Regulatory Services Engineer	805	545-4289

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRPDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NRPDS
X	S J	S S V	R 4 3 6	N					

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MON	DAY	YR
[ ] YES (If yes, complete EXPECTED SUBMISSION DATE)	[X] NO				

ABSTRACT (16)

On March 29, 1997, at 1057 PDT, with Unit 2 in Mode 1 (Power Operation) at 100 percent power, the Unit 2 reactor tripped on steam generator (SG) water level low-low in SG 2-2. The Unit was stabilized in Mode 3 (Hot Standby) in accordance with plant emergency procedures. A 4-hour, non-emergency report was made to the NRC at 1209 PDT in accordance with 10 CFR 50.72 (b)(2)(ii).

The low-low SG water level was caused by the failure of Main Feedwater Pump (MFWP) 2-1. The feedwater pump failed when a solenoid-operated shuttle valve in the control oil supply to the MFWP turbine governor valve jammed which resulted in the governor valve drifting shut. The valve failure was determined to be caused by iron oxide (rust) particulate contamination buildup in the valve spool. The iron oxide particulate generation occurred in the feedwater pump oil system as a result of water contamination. Steam/moisture entered the oil system from a potentially degraded inboard turbine seal via the adjacent bearing oil seal.

The MFWP 2-1 lube oil system was flushed. The associated filters were replaced. Water contamination was minimized by throttling MFWP 2-1 turbine gland seal supply steam. The planned maintenance and predictive maintenance systems are being improved to ensure proper operation of the MFWP control oil system. The MFWP inboard turbine gland seal will be repaired or replaced in the next refueling outage.

TEXT

I. Plant Conditions

Unit 2 was operating in Mode 1 (Power Operation) at 100 percent power at the time of this event.

II. Description of Problem

A. Summary

On March 29, 1997, at 1057 PDT, with Unit 2 in Mode 1 at 100 percent power, the Unit 2 reactor (JC)(RCT) tripped on steam generator (SB)(SG) water level low-low in SG 2-2. The Unit was stabilized in Mode 3 (Hot Standby) in accordance with plant emergency procedures. A 4-hour, non-emergency report was made to the NRC at 1209 PDT in accordance with 10 CFR 50.72 (b)(2)(ii).

B. Background

The main feedwater pump (MFWP) (SJ)(P) is a single-stage centrifugal pump. Each pump has an independent oil system (SL) used to lubricate and cool bearings, control the stop (SJ)(V) and governor valves (SJ)(V), and provide control oil to the MFWP trip system (JK).

Operating Procedure (OP) L-7, "Plant Stabilization Following Reactor Trip," provides instructions for recovery from a plant transient that results in a reactor trip or safety injection. The intent of this procedure is to stabilize the plant at normal operating pressure and normal operating temperature.

Abnormal Operating Procedure OP AP-15, "Loss of Feedwater Flow," provides guidance to mitigate flow transients caused by the trip of a MFWP, Heater 2 Drain Pump (SD)(P), or a condensate/booster pump set (SD)(P).

C. Event Description

On March 29, 1997, at 0938 PDT, the MFWP 2-1 standby Lovejoy control oil filter (SL)(FLT) high differential pressure (dP) alarm was received by the control room operators. At approximately 1051 PDT, following the replacement of this standby filter element, a second high dP alarm was received for the in-service filter. Upon initiation of

TEXT

a transfer to the standby filter, the speed of MFWP 2-1 dropped rapidly, resulting in the inability to produce sufficient discharge pressure to feed the SGs. Operators attempted to transfer the control oil system back to the original in-service filter without success. At approximately 1055 PDT, a ramp to 50 percent power was initiated.

Operators entered OP AP-15 for the loss of a MFWP. To compensate for the partial loss of feedwater, actions were taken to rapidly reduce load to 50 percent, and all three auxiliary feedwater (AFW) pumps were manually started. The loss of feedwater, coupled with the load reduction, caused the water level in SG 2-2 to fall below the SG water level low-low reactor trip setpoint. An automatic reactor trip was initiated. The Unit was stabilized in Mode 3 in accordance with plant emergency procedures. A 4-hour, non-emergency report was made to the NRC at 1209 PDT in accordance with 10 CFR 50.72 (b)(2)(ii).

Following the trip, the reactor coolant system cooled to below the normal operating temperature of 547°F. To prevent excessive cooldown, operators manually closed the main steam isolation valves (MSIVs), as provided by procedures, and removed decay heat via the 10 percent atmospheric dump valves (ADVs). The cooldown resulted from the three AFW pumps injecting cold water into the SGs prior to the reactor trip. The lowest temperature reached was 534 °F.

During plant stabilization, operators reclosed the reactor trip breakers, in accordance with plant procedures, to relatch the turbine. Since a load rejection control signal from the rapid ramp to 50 percent load was still present, the ADVs temporarily shifted to the load rejection control mode (controlling average reactor coolant temperature to a programmed reference temperature). As a result of the reference temperature being greater than reactor coolant average temperature, the ADVs closed, and at least two main steam safety valves (MSSVs) lifted on demand at approximately 1,060 psig. Operators selected the steam pressure control mode for the ADVs, the ADVs opened, and the safety valves reseated. The MSIVs were subsequently reopened to utilize the main condenser for removal of residual heat and preclude the need for the ADVs.

TEXT

Diesel Generators (DG) 2-2 and 2-3 started due to a momentary dip of bus voltage during the bus transfer to startup power, but as designed, did not load.

D. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

E. Dates and Approximate Times for Major Occurrences

1. March 29, 1997 at 1057 PDT: Event date / discovery date: Unit 2 reactor trip.

2. March 29, 1997 at 1209 PDT: A 4-hour non-emergency report was made to the NRC in accordance with 10 CFR 50.72 (b)(2)(ii)

F. Other Systems or Secondary Functions Affected

The two motor-driven AFW pumps and the turbine-driven AFW pump were started manually in an attempt to restore SG water level.

DGs 2-2 and 2-3 started due to a momentary voltage dip on their respective vital buses. The voltage dip was not long enough to cause loading of the diesels onto their respective vital buses. DG 2-1 did not receive the anticipatory start signal due to different loading conditions on its vital bus.

G. Method of Discovery

The event was immediately apparent to plant operators due to alarms and indications received in the control room.

H. Operator Actions

Licensed plant operators in the control room responded in accordance with established emergency procedures, confirmed the reactor trip, verified proper engineered safety feature actuations, and initiated manual actions to stabilize the Unit in Mode 3.

TEXT

Operators closed the MSIVs to prevent an excessive cooldown.

I. Safety System Responses

1. The reactor trip breakers (JC)(BKR) opened.

2. The main turbine (TA)(TRB) tripped (turbine stop valves closed).

3. The control rod drive mechanism (AA)(DRIV) allowed the control rods to drop into the core.

4. At least two MSSVs (SB)(RV) lifted within their expected lift settings when the 10 percent steam dumps closed.

III. Cause of the Problem

A. Immediate Cause

The low-low SG water level was caused by the failure of MFWP 2-1. The MFWP failed when a solenoid-operated shuttle valve (SV-1509), in the control oil supply to the MFWP turbine governor valve, jammed in mid-position. This resulted in inadequate flow of control oil to the governor, which resulted in the governor valve drifting shut. The ability to completely shift control oil trains and speed control of the pump were lost. Upon removal of the valve, bench testing determined that the solenoid had burned out due to the valve being stuck in the mid-position.

B. Root Cause

The valve failure was determined to be caused by iron oxide (rust) particulate contamination buildup in the valve spool. The iron oxide particulate generation occurred in the feedwater pump oil system as a result of water contamination. Steam/moisture entered the oil system from a degraded inboard turbine steam seal via the adjacent bearing oil seal. Although it was determined that the higher concentration of water in the lubricating oil would not significantly reduce its lubricating properties, insufficient consideration was given to the effects of the corrosion of the carbon steel components on the control oil system.

TEXT

C. Contributory Cause

The planned maintenance and predictive maintenance systems were inadequate to address a contaminated control oil system.

IV. Analysis of the Event

A reactor trip from 100 percent power is a previously analyzed Final Safety Analysis Report Update, Condition II Event, as noted in Chapter 15.2.8, "Loss of Normal Feedwater." The reactor protection system (JC)(RPS) responded as designed and initiated a reactor trip on SG water level low-low. The Unit was stabilized in Mode 3 in accordance with approved plant procedures.

After review of previous reactor trip data, PG&E determined that the plant cooldown was consistent with several past reactor trips. The anticipatory starts of DG 2-2 and 2-3 were consistent with previous events during the momentary vital bus voltage dip that occurs during transfer to the startup bus. The MSSVs lifted within their expected lift settings.

Thus, the health and safety of the public were not affected by this event.

V. Corrective Actions

A. Immediate Corrective Actions

The lube oil system for MFWP 2-1 was flushed and the filters and strainer were replaced. The valve actuators were inspected and cleaned.

The solenoid-operated shuttle valve (SV-1509) in the control oil system for MFWP 2-1 was replaced. Four additional solenoid-operated shuttle valves in the control systems for high pressure actuator valves, SV-154 and 155, and the low pressure actuator valves, SV-152 and 153 were found to be sticking and were replaced. Although they did not contribute to this event, other solenoid-operated shuttle valves from the same manufacturer, subject to the same contaminated control oil, were replaced.

The water content of the control oil system for the other MFWPs on both units were verified to be within acceptable limits.

TEXT

B. Corrective Actions to Prevent Recurrence

The planned maintenance and predictive maintenance systems are being improved to ensure proper operation of the MFWP control oil system. Included are tighter quality requirement for the control oil system and increased testing requirements.

The MFWP inboard turbine gland steam seal will be repaired or replaced in the next Unit 2 refueling outage, currently scheduled to begin February 7, 1998. Throttling of MFWP 2-1 turbine gland steam will be performed as applicable to minimize sealing steam leakage, until the seal is replaced.

Operating Procedure OP L-7 was revised to add a caution regarding the effect closing reactor trip breakers has on the control mode of the ADVs.

VI. Additional Information

A. Failed Components

SV-1509 - solenoid-operated shuttle valve in MFWP 2-1 control oil system.

SV-152 and 153 - solenoid-operated shuttle valves in the low pressure actuator.

SV-154 and 155 - solenoid-operated shuttle valves in high pressure actuator.

Manufacturer: Racine Hydraulics Division of Dana Corporation
Model/manufacturer number: FD4DNKS102S70AC

B. Previous LERs on Similar Problems

A review of historical data showed no reactor trips occurring in the last 10 years due to problems with the condition of the control/lube oil.